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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK VOLUME 155

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CH-3 IN-FLIGHT CREW NOISE(U) AIR FORCE AEROSPACE

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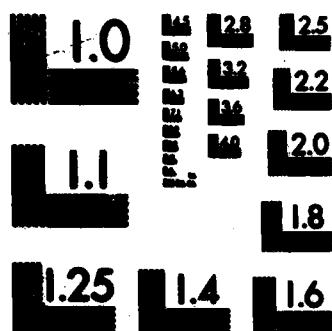
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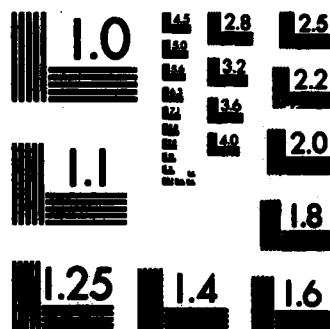
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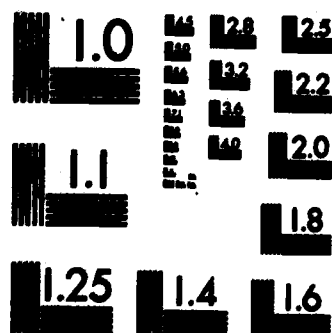
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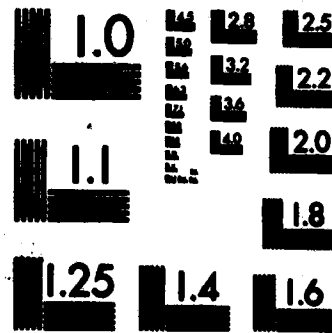
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Volume 155



USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 155

CH-3 IN-FLIGHT CREW NOISE

SEPTEMBER 1982

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AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
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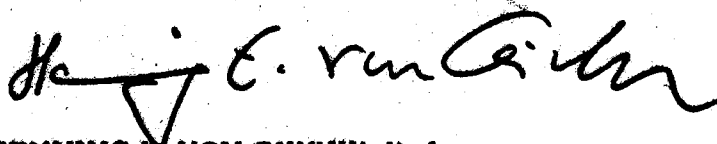
TECHNICAL REVIEW AND APPROVAL

AMRL-TR-75-50, Vol. 185

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



HENNING B. VON GIERKE, Dr Ing
Director
Biodynamics and Bioengineering Division
Air Force Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) → The CH-3 is a USAF tactical combat transport helicopter. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this helicopter during normal flight operations. Data are reported for nine locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise →		

levels, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Air Force Aerospace Medical Research Laboratory, under Project/Task 723109, Communication and Performance Capability and Operational Noises. The author acknowledges the efforts of Mr. John Cole who established the data analysis requirements, Mr. Henry Mohlman, and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.

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INTRODUCTION

The CH-3 is a USAF transport helicopter used to transport personnel or aerospace hardware. The helicopter, which is manufactured by the Sikorsky Aircraft Division of the United Technologies Corporation, is powered by two T58-GE-5 turboshaft engines each rated at 1500 shp. The engines drive both a four-blade fully-articulated 19m diameter main rotor and a conventional four-blade 4.2m diameter tail rotor. The engines are manufactured by the General Electric Company, Aircraft Engine Group, Military Engine Division.

This volume provides measured and extrapolated data defining bioacoustic environments produced inside this helicopter. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the CH-3 helicopter.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published.

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1. Cole, John N. USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application, AMRL-TR-75-50(1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured CH-3 helicopter during typical speed, altitude, and flight maneuver conditions. These levels describe the standard CH-3 environments, but may not be representative of those levels encountered if the helicopter has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at various flight crew locations. Table 1 lists the measurement locations and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone position was at ear level external to headgear in a region 0.2-0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases, the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter and the resultant samples analyzed using a 4- or 8- second integration time to obtain a power-averaged level, which effectively smooths out short-duration fluctuations and best describes the exposure.

Although the presence of a crew member at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurement locations.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the HH-43B helicopter at the 9 specified locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

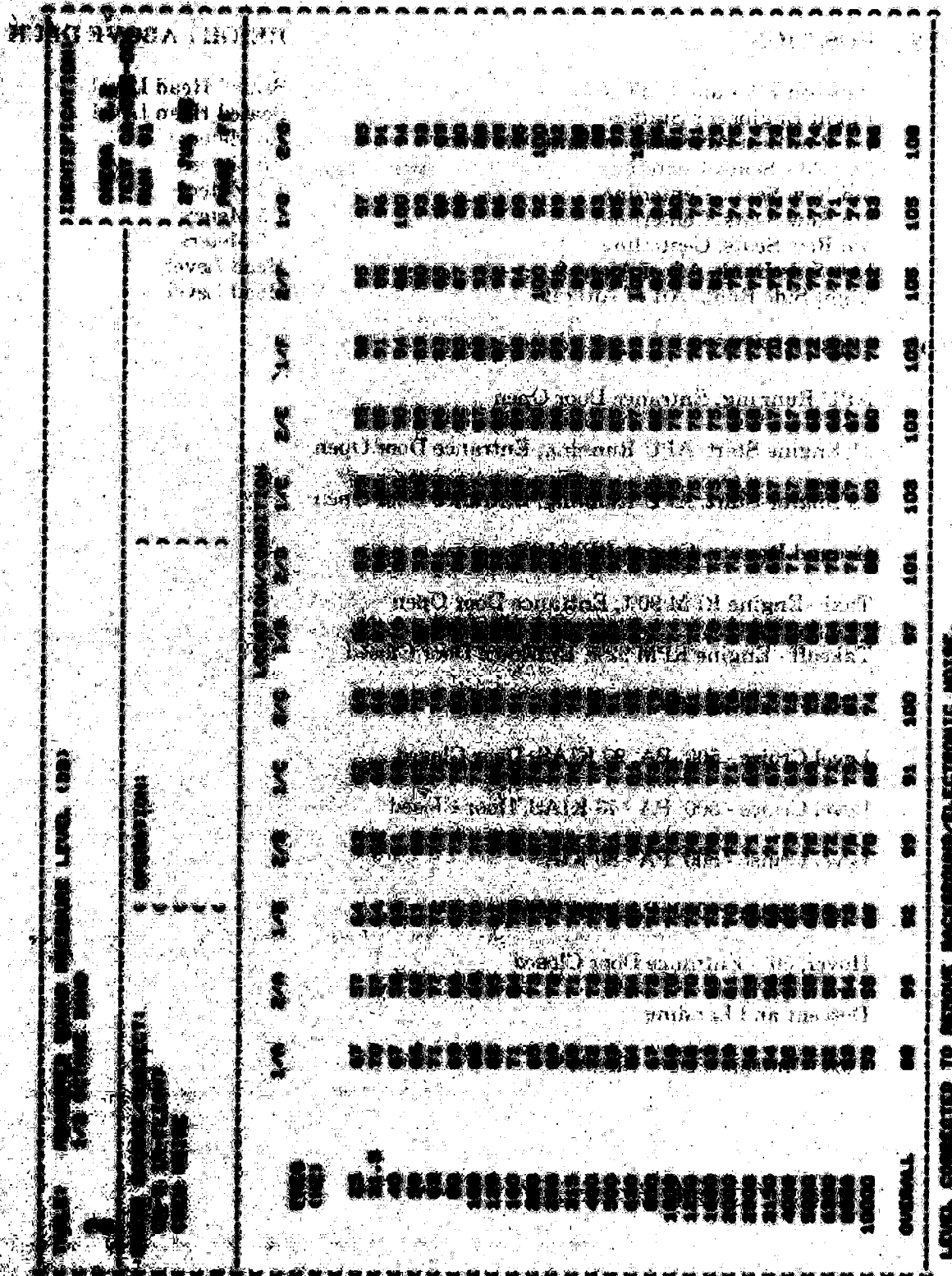
TABLE 1**MEASUREMENT LOCATIONS AND TEST CONDITIONS**

CH-3, Andrews AFB, 8 June 1982

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Between Pilot and Copilot	Seated Head Level
2	Flight Engineer's Station	Seated Head Level
3	1st Row Seat Across From Entrance Door	1.5 Meters
4	2nd Row Seats, Centerline	1.5 Meters
5	3rd Row Seats, Centerline	1.5 Meters
6	4th Row Seats, Centerline	1.5 Meters
7	5th Row Seats, Centerline	1.5 Meters
8	Left Side Bunk, Aft of Aircraft	Head Level
9	Right Side Bunk, Aft of Aircraft	Head Level

CONDITION	DESCRIPTION
A	APU Running, Entrance Door Open
B	#1 Engine Start, APU Running, Entrance Door Open
C	#2 Engine Start, APU Running, Entrance Door Open
D	Ground Runup - Engine RPM 80%
E	Taxi - Engine RPM 90%, Entrance Door Open
F	Takeoff - Engine RPM 92%, Entrance Door Closed
G	Liftoff Climb to 500'
H	Level Cruise - 500' PA, 90 KIAS, Door Closed
I	Level Cruise - 500' PA - 70 KIAS, Door Closed
J	Level Cruise - 500' PA - 80 KIAS
K	Level Cruise - 1000' PA - 120 KIAS
L	Hover, 50' - Entrance Door Closed
M	Descent and Landing
O	Taxi - Entrance Door Closed

1000



LEVEL CORRECTED TO ABOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)															IDENTIFICATION:	
1/3 OCTAVE BAND																
															OMEGA 3.2	
															TEST CA-082-001	
															RUN 02	
															27 JUL 82	
															PAGE F2	
NOISE SOURCE/SUBJECT:																
CH-3 IN-FLIGHT																
CREW NOISE																
															</	

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION:	
2														OMEGA 3.2	
NOISE SOURCE/SUBJECT:														TEST CA-082-001	
CH-3 IN-FLIGHT														RUN 03	
CREW NOISE														27 JUL 82	
														PAGE F3	
LOCATION/CONDITION															
FREQ (HZ)	6/J	7/J	8/J	9/J	1/K	2/K	3/K	5/K	1/L	2/L	3/L	1/M	1/O		
25	94	94	93	94	96	91	92	96	95	90	94	91	90		
31.5	98	99	93	90	103	97	100	102	101	97	95	92	82		
40	94	95	92	92	96	92	95	95	94	91	89	97	88		
50	96	94	97	99	93	96	97	98	91	96	95	97	93		
63	85	87	89	94	91	92	89	90	90	92	89	92	90		
80	88	88	91	92	95	96	94	95	94	97	92	95	90		
100	91	90	91	96	93	95	94	96	93	96	95	95	90		
125	92	94	99	96	93	96	94	98	93	95	94	93	94		
160	92	91	95	95	92	98	96	95	90	96	93	95	99		
200	93	89	90	91	95	101	94	95	91	99	95	98	97		
250	89	88	90	91	92	96	94	95	89	95	93	94	91		
315	86	88	88	89	91	93	92	91	90	93	95	91	92		
400	85	84	86	87	89	92	91	89	88	94	91	89	90		
500	85	84	84	85	90	93	91	88	88	94	90	89	86		
630	95	95	90	87	91	94	96	99	89	95	96	96	93		
800	89	87	85	88	84	88	89	89	82	91	88	90	86		
1000	87	85	84	84	82	86	86	86	80	86	85	82	81		
1250	88	86	84	79	83	87	89	90	80	87	90	81	80		
1600	82	80	79	81	80	84	82	82	77	84	83	81	80		
2000	77	74	73	75	77	79	78	77	74	79	77	75	73		
2500	73	70	69	70	77	79	75	75	73	78	76	76	72		
3150	74	70	69	70	74	77	75	76	72	77	79	74	72		
4000	67	65	65	68	75	81	73	69	73	79	71	75	72		
5000	65	63	63	65	75	79	71	68	71	77	69	73	73		
6300	64	62	63	65	72	75	69		70	75	66	72	70		
8000	63	62	63	65	74	78	71		71	77	66	75	72		
10000	69	66	68	69	80	86	78	69	80	87	73	84	89		
OVERALL	105	105	105	105	107	108	107	108	105	107	105	106	105		
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.															

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													
OCTAVE BAND													
2													
IDENTIFICATION:													
OMEGA 3.2													
TEST CA-092-001													
RUN 01													
27 JUL 82													
PAGE J1													
NOISE SOURCE/SUBJECT: OPERATION:													
CA-3 IN-FLIGHT													
CREW NOISE													
LOCATION/CONDITION													
1/A 2/A 1/B 2/B 1/C 2/C 1/D 2/D 1/E 2/E 1/F 2/F 1/G 2/G													
FREQ (HZ)													
31.5	73	61	68	67	72	72	90	88	100	100	96	102	98
63	74	78	74	80	79	85	89	94	91	90	93	95	96
125	82	95	83	96	87	96	91	95	93	92	98	92	96
250	73	77	83	89	83	92	89	96	92	94	100	94	100
500	86	96	90	95	84	95	89	94	98	94	100	95	106
1000	72	75	76	82	78	85	80	83	83	85	88	86	88
2000	65	67	75	80	76	82	73	76	76	79	82	80	81
4000	58	61	72	77	73	79	71	75	72	77	82	78	79
8000	57	59	75	78	77	83	82	88	80	79	83	83	86
OVERALL	88	99	92	99	91	100	97	101	103	103	105	105	108

TABLE: MEASURED SOUND PRESSURE LEVEL (dB)
OCTAVE BAND

2

IDENTIFICATION:

OMEGA 3.2
TEST CA-082-001
RUN 03
27 JUL 82
PAGE J3

NOISE SOURCE/SUBJECT: OPERATION:

CH-3 IN-FLIGHT
CREW NOISE

LOCATION/CONDITION

6/3 7/3 8/3 9/3 1/K 2/K 3/K 5/K 1/L 2/L 3/L 1/M 1/O

FREQ
(Hz)

31.5	101	101	97	97	104	99	102	103	102	99	98	99	93
63	97	96	98	100	98	100	99	100	97	100	97	100	96
125	96	97	101	100	97	101	100	101	97	100	99	99	100
250	95	93	94	95	98	103	98	99	95	101	99	100	99
500	96	95	92	91	95	98	98	99	99	99	98	98	95
1000	93	91	89	90	88	92	93	93	86	93	93	91	88
2000	83	81	80	82	83	86	84	83	80	86	85	83	81
4000	75	72	71	72	79	84	78	77	77	82	80	79	77
8000	71	68	70	71	82	87	79	77	81	87	74	84	89
OVERALL	105	105	105	105	107	108	107	108	105	107	105	106	105

TABLE: MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:	
3													OMEGA 3.2	
NOISE SOURCE/SUBJECT: (OPERATION:													TEST CA-082-001	
CH-3 IN-FLIGHT													RUN 01	
CREW NOISE													27 JUL 82	
													PAGE H1	
LOCATION/CONDITION														
1/A	2/A	1/B	2/B	1/C	2/C	1/D	2/D	1/E	2/E	1/F	2/F	1/G	2/G	
HAZARD/PROTECTION														
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR														
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR														
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)														
NO PROTECTION														
OASLC	88	99	92	99	91	100	96	101	102	102	101	105	103	108
OASLA	84	94	88	93	85	95	89	94	96	96	94	100	95	104
T	480	85	240	101	404	71	202	85	60	60	85	30	71	15
HGU-2A/P HELMET WITH H-154														
OASLC	73	83	78	84	77	86	82	88	86	86	86	92	87	94
T	960	571	960	480	960	339	679	240	339	339	339	120	285	85
HGU-2A/P HELMET WITH H-154(A)														
OASLC	68	78	73	80	72	81	78	83	82	82	82	88	82	89
T	960	960	960	960	960	807	960	571	679	679	679	240	679	202
HGU-2A/P HELMET WITH CUSTOM LINER														
OASLC	81	91	85	90	81	91	86	91	93	93	91	97	92	101
T	807	143	404	170	807	143	339	143	101	101	143	50	120	25
U-SIR EAR PLUGS														
OASLC	62	71	65	71	61	71	66	71	73	73	71	77	72	81
T	960	960	960	960	960	960	960	960	960	960	960	960	960	807
H-157 IN-FLIGHT COMMUNICATION UNIT														
OASLC	65	76	69	77	69	78	74	80	78	78	78	84	78	85
T	960	960	960	960	960	960	960	960	960	960	960	480	960	404
COMMUNICATION														
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)														
PSIL	74	79	80	85	79	87	81	84	86	86	90	87	92	
ANNNOYANCE														
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)														
TONE CORRECTION (C IN DB)														
PNLT	98	107	103	109	100	110	104	110	112	112	110	116	111	120
C	4	5	4	4	2	3	2	3	5	5	3	4	3	5
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.														

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE

3	IDENTIFICATION:
	OMEGA 3.2
	TEST CA-082-001
	RUN 02
	27 JUL 82
	PAGE 12

1/H	2/H	3/H	4/H	5/H	6/H	7/H	8/H	9/H	5/I	2/J	3/J	4/J	5/J
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

HAZARD/PROTECTION

C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)
NO PROTECTION

OASLC	100	105	103	104	104	103	99	99	99	100	104	104	103	105
OASLA	92	98	96	96	96	95	92	92	92	95	96	96	99	99
T	120	42	60	60	60	71	120	120	120	71	60	60	36	36
HGU-2A/P HELMET WITH H-154														
OASLAS	84	92	88	89	88	87	85	85	84	85	89	89	89	90
T	480	120	240	202	240	285	404	404	480	404	202	202	202	170
HGU-2A/P HELMET WITH H-154(A)														
OASLAS	80	88	84	85	84	83	81	81	80	82	85	85	86	86
T	960	240	480	404	480	571	807	807	960	879	404	404	359	359
HGU-2A/P HELMET WITH CUSTON LINER														
OASLAS	89	95	93	93	92	92	90	90	89	92	93	93	93	96
T	202	71	101	101	120	120	170	170	202	120	101	101	71	60
U-51R EAR PLUGS														
OASLAS	70	75	73	73	73	72	70	70	69	72	73	73	76	76
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960
H-157 IN-FLIGHT COMMUNICATION UNIT														
OASLAS	77	84	79	82	81	80	77	77	77	77	81	81	81	82
T	960	480	960	679	807	960	960	960	960	960	807	807	807	679

COMMUNICATION

PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)														
PSIL	85	90	89	90	90	89	86	86	85	88	88	91	93	

ANNOYANCE

PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PH88)														
TONE CORRECTION (C IN DB)														
PNLT	107	113	111	111	113	109	106	106	105	111	111	111	114	115
C	2	3	3	2	3	2	2	2	1	4	3	3	3	3

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE										IDENTIFICATION:	
3										OMEGA 3.2	
										TEST CA-082-001	
CH-3 IN-FLIGHT										RUN 03	
CREW NOISE										27 JUL 82	
										PAGE H3	
										</	